
खान केज निलंबन गियर में वेष्टन
भाग 1 सामान्य अपेक्षायें
(दूसरा पुनरीक्षण)

Cage Suspension Gear for
Winding in Mines

Part 1 General Requirements
(Second Revision)

ICS 73.100.40

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FOREWORD

This Indian Standard (Part 1) (Second Revision) was adopted by the Bureau of Indian Standards on after the draft finalized by the Mining Techniques and Equipment Sectional Committee, had been approved by the Mechanical Engineering Division Council.

This standard deals with the suspension gear used for suspension of cages or skips for winding in mines.

This standard was originally published in 1975 and subsequently revised in 2004.

This Indian Standard is published in eight parts. The other parts in this series are:

- | | |
|--------|--|
| Part 2 | Cappels |
| Part 3 | Shackles and pins |
| Part 4 | Bridle chains |
| Part 5 | Equalizing plates |
| Part 6 | Safety detaching hooks (4 plates type) |
| Part 7 | Safety detaching hooks (4 plates type) 120, 150 and 200 kN capacity |
| Part 8 | Winding in mines — Suspension gear — Clivey hook suspension arrangements |

At the time of enquiry or order, the information specified in Annex A shall be given.

The Composition of the Committee responsible for the formulation of this standard is given in Annex D.

For the purpose of deciding whether a particular requirement of this standard is complied with the final value, observed or calculated, expressing the result of a test or analysis shall be rounded off in accordance with IS 2 : 1960 'Rules for rounding off numerical values (*revised*)'. The number of significant places retained in the rounded off value should be the same as that of the specified value in this standard.

Indian Standard

CAGE SUSPENSION GEAR FOR WINDING IN MINES

PART 1 GENERAL REQUIREMENTS

(*Second Revision*)

1 SCOPE

This standard (Part 1) prescribes the general requirements consistent with safety, regarding the material, design, manufacture, testing and examination for various components of cage suspension gear used for suspension of cages for winding in mines.

2 REFERENCES

The following standards contain provisions which through reference in this text, constitute provision of this standard. At the time of publication, the editions indicated were valid. All standards are subject to revision, and parties to agreements based on this standard are encouraged to investigate the possibility of applying the most recent editions of the standards:

<i>IS No.</i>	<i>Title</i>
1598 : 1977	Method for Izod impact test for metals (<i>first revision</i>)
3073 : 1967	Assessment of surface roughness
3703 : 2004	Recommended practice for magnetic particle flaw detection (<i>second revision</i>)
4163 : 2004	Steel — Determination of content of nonmetallic inclusions — Micrographic method using standard diagrams (<i>third revision</i>)
4432 : 1988	Case hardening steels — Specification (<i>first revision</i>)
5517 : 1993	Steel for hardening and tempering — Specification (<i>second revision</i>)
13805 : 2004	General standard for qualification and certification of non-destructive testing personnel (<i>first revision</i>)

3 TERMINOLOGY

For the purpose of this standard, the nomenclatures given in Fig. 1 to 3 and the following definitions shall apply.

3.1 Static Working Load (Safe Working Load) — It consists of the aggregate load suspended on suspension gear and shall include the weight of suspension gear (*see also Annex B*).

3.2 Proof Load — The non-destructive tensile load to which the components are subjected to in the finished condition.

3.3 Breaking Load — The destructive tensile load to which the components are subjected to in the finished condition.

3.4 Factor of Safety — The factor of safety is the ratio between the breaking load and the static working load as defined in **3.1** and **3.3** respectively.

4 MATERIAL

4.1 Component of cage suspension gear shall be manufactured from any one of the following types of steels:

- a) Steel conforming to 20C15 of IS 5517,
- b) Steel conforming to 20NiCr2Mo2 of IS 4432, and
- c) Steel conforming to MS to IS 2062 Grade E-250 in normalizing condition for detaching plate/catch plate.

4.2 The inclusion rating for A, B, C and D type of non-metallic inclusion as given in IS 4163 shall not exceed 1.5.

5 HEAT TREATMENT

5.1 All components of cage suspension gear, after all forging and welding operations during manufacture and repair shall be heat-treated according to **5.2** to get optimum mechanical properties.

5.2 The components of cage suspension gear shall be either normalized or normalized and tempered, or hardened and tempered, or refined and hardened and tempered as indicated below:

<i>Designation of Steel</i>	<i>Normalizing Temperature °C</i>	<i>Hardening Temperature °C</i>	<i>Tempering Temperature</i>	<i>Quenching Agent</i>
(1)	(2)	(3)	(4)	(5)
20C15	860-900	860-900	550-660	Water or oil
20Ni2Cr2Mo2	*	820-850	*	Water

*Suitable temperature may be adopted so as to obtain the optimum properties.

5.3 After heat treatment, hardness of various materials for various components shall be as given below:

<i>Material/Part</i>	<i>Hardness HV</i>
20C15	200 to 230
20Ni2Cr2Mo2	250 to 280
Bridle chain	270 to 330

5.4 Izod impact test values of the specimens of the above components when tested in accordance with IS 1598 after heat treatment shall not be less than 48 Joule.

6 DESIGN

6.1 The design of all components of cage suspension gear shall be such that the factor of safety shall not be less than 10 and shall eliminate accidental disconnections. Threaded joints shall be avoided as far as possible but if the same cannot be avoided, factor of safety of the threaded joints shall be at least 15.

6.2 Dimensions

The form and dimensions of various components of suspension gear shall be as specified in relevant parts of this standard.

7 MANUFACTURE

7.1 All components of suspension gear shall be of sound construction, free from defects like cracks, roughness, deep tool marks, deep notches, etc, and shall be of good workmanship. There shall be no sharp reduction in cross section or sharp radius.

7.2 The recommended hot working temperatures are as follows:

<i>Designation of Steel</i>	<i>Temperature °C</i>
20C15	1200 to 850
20Ni2Cr2Mo2	1150 to 900

7.3 Freedom from Defects

7.3.1 Each component shall be made by either forging or machining from slabs or bars. Billets, blooms, slabs and bars for the manufacture shall be free from cracks, surface flaws, laps and other surface defects which may result in defects in forgings made therefrom.

7.3.1.1 Manufacture shall have adequate manufacturing and forging facilities. For forging the recommendation of hammer capacities as follows:

- a) *Up to 10 tonne SWL* — Minimum 250 Kg hammer.
- b) *Up to 12 tonne SWL* — Minimum 500 Kg hammer.
- c) *Up to 20 tonne SWL* — Minimum 1 000 Kg hammer.

7.3.2 All plates, sections and bars shall be well and cleanly rolled to the dimensions specified, and shall be sound and free from flaws, laminations, cracks or other defects.

7.4 Flame Cutting and Machining

Where flame cutting of steel plate is necessary suitable margin shall be provided for removal by final machining to produce a finished surface free from irregularities and decarburization zones.

7.4.1 Prior to final finish and subsequent to flame cutting, machining, forging and welding, all components shall be hardened and tempered as required. The components shall be machined from solid as far as possible.

7.4.2 Surface finish (*see* IS 3073) of the various parts of the cage suspension gear shall be as given below:

<i>Part Surface Finish</i>	<i>Microns</i>
Pins and holes	0.8 to 1.6
Mating surfaces	1.6 to 3.2
Outside surfaces	3.2 to 6.4

7.5 Bridle Chains

The manufacture of bridle chains shall be carried out, as far as possible, by automatic chain bending

machines. They shall be joined by either resistance or flash butt-welding process under carefully controlled conditions.

8 ARRANGEMENT OF SUSPENSION

8.1 Some typical arrangements of cage suspension are shown in Fig. 1 to 3.

8.1.1 Adjusting links may also be used in place of adjusting plates shown in Fig. 2 and 3. The purpose of these plates and links is to adjust the rope stretch.

8.1.1.1 Adjusting plates and adjusting links are optional and shall be designed to carry the static load suspended on them.

8.2 The inclination of bridle chains to the vertical plane shall not exceed 30° , that is, the included angle between the two diagonal chains shall not exceed 60° .

8.3 The inclination of cage hanger shall correspond to inclination of bridle chain.

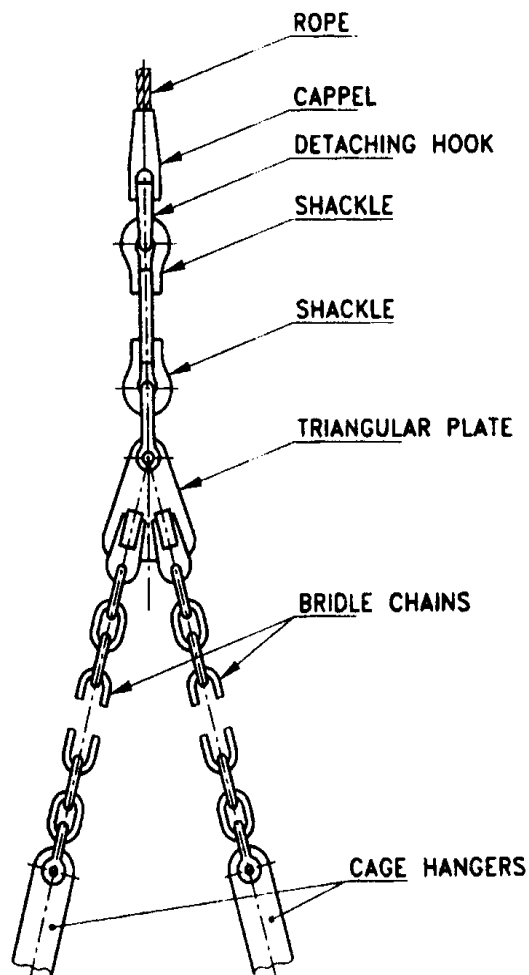


FIG. 1 TYPICAL ARRANGEMENT OF CAGE SUSPENSION WITH SHACKLES

9 TESTING AND EXAMINATION

9.1 Manufacturer shall have their own magnetic particle flaw detector and ultrasonic flaw detector along with testing personnel for carrying out these tests shall have requisite NDT level-II (*see* IS 13805) competency certificate issued by ISNT/ASNT.

9.2 Notwithstanding with any provision for statutory requirements, prototype of the component shall be tested to destruction to ensure the minimum factor of safety of 10 in the component. The above test shall be made in a test house approved by the appropriate authority permitting the use of suspension arrangement. Prototype of CSG and its components shall be tested for its:

- Safe working load;
- Proof load;
- Breaking load;

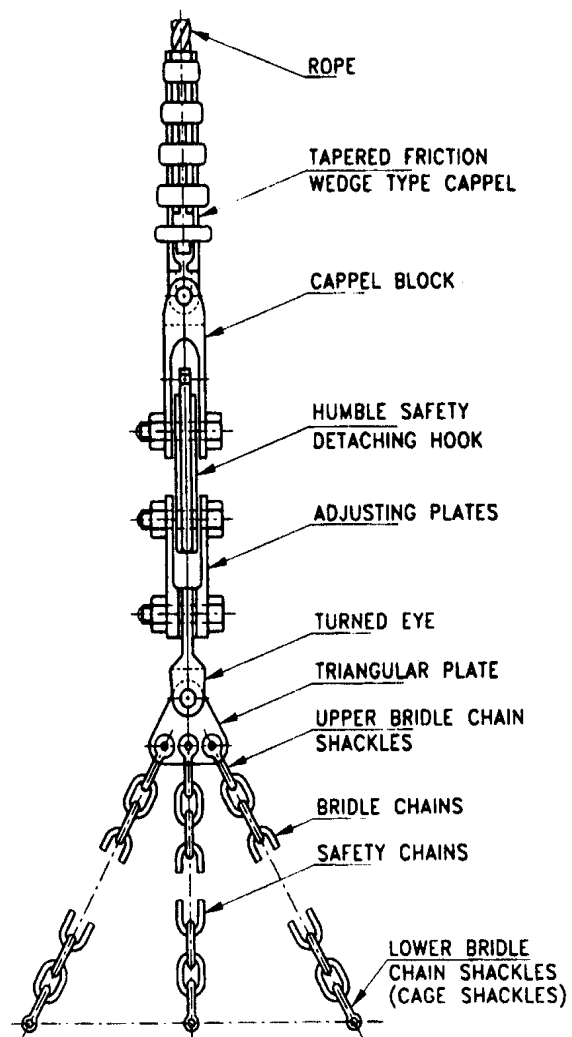


FIG. 2 TYPICAL ARRANGEMENT OF CAGE SUSPENSION WITH BLOCKS AND LINKS

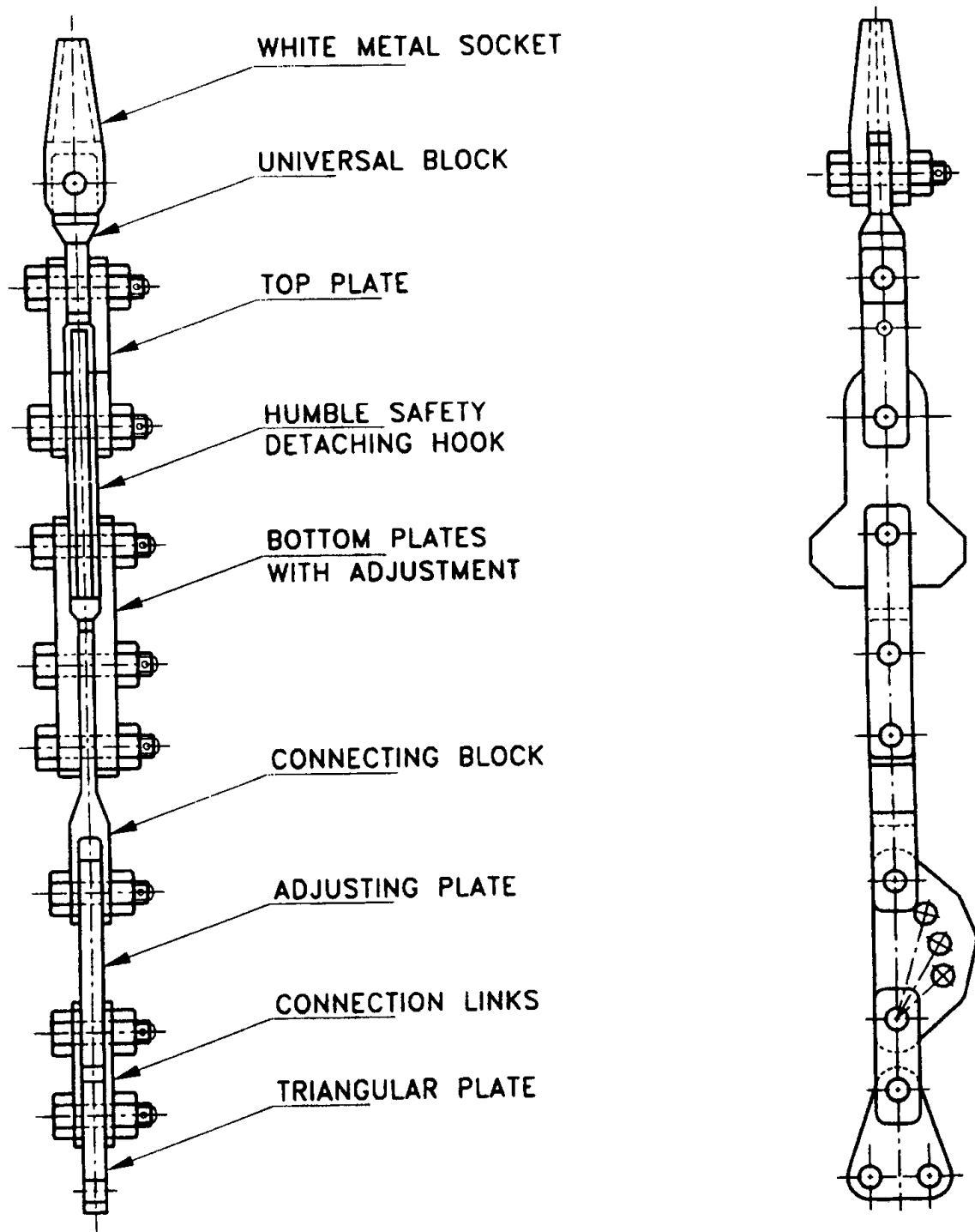


FIG. 3 TYPICAL ARRANGEMENT OF CAGE SUSPENSION
WITH LINKS AND ADJUSTING PLATE

- d) Non-destructive test ;
- e) Chemical analysis;
- f) Micro examination;
- g) Hardness;
- h) Izod impact test; and
- j) Inclusion rating.

The tests shall be at any Government approved laboratory or a test house accredited by NABL/APLAC/ILAC, subject to confirmation to its ability to conduct such tests, along with testing personnel for carrying out NDT shall have requisite NDT level-III (see IS 13805) competency certificate issued by ISNT/ASNT

9.3 Proof Load Test

Each finished component of suspension gear separately or collectively, shall be subjected to tensile proof load as specified in relevant parts of this standard and shall satisfactorily withstand the test without any permanent deformation or defect. Each component shall be separately and thoroughly examined for cracks after proof load test, visually and by means of other suitable devices. Magnetic crack detection, gamma-ray, X-ray and ultrasonic tests shall be conducted as required.

9.4 Permissible imperfections for magnetic particle inspection of various cage suspension gear components are given in Annex C.

9.5 The statutory authority may inspect, check and examine the manufacturing facilities at any time and get samples tested during the course of inspection or send such samples for testing at any Govt. approved laboratories or a test house accredited by NABL/APLAC/ILAC, subject to confirmation to its ability to conduct such tests.

9.6 Certificate of Test

Every component of suspension gear manufactured and tested as specified in this standard shall be certified by the testing authority in an appropriate proforma. If agreed to between the user and the manufacturer, the user or his representative shall be provided with the facilities for witnessing the tests as laid down in this standard.

10 PAINTING

The components of suspension gear shall be supplied with a coat of anticorrosive dressing.

11 MARKING

11.1 Each component shall be permanently and legibly marked on a non-wearable portion of the part with the

following information:

- a) Manufacturer's identification mark;
- b) Safe working load;
- c) Abbreviated name for material; and
- d) Inspection marking — After testing, when the test results are in conformity with the specification, inspection mark shall be stamped on the components.

NOTE — Symbol 'C' shall be employed for 20C 15 steel and symbol 'A' shall be employed for 20 Ni2Cr2Mo2 steel.

11.2 The size of marking shall be as follows:

<i>Safe Working Load (kN)</i>	<i>Size of mark (mm)</i>
Upto 30	3
Over 30 and up to 50	5
Over 50	6

11.3 BIS Certification Marking

The product(s) conforming to the requirements of this standard may be certified as per the conformity assessment schemes under the provisions of the *Bureau of Indian Standards Act, 2016* and the Rules and Regulations framed thereunder, and the products may be marked with the Standard Mark.

12 PACKING

All components of suspension gear shall be packed and suitably protected to avoid damage in transit.

13 CERTIFICATE OF TEST

The manufacturer shall provide a certificate with each consignment of different items of suspension gear or with individual items if the purchaser so specifies giving the following information:

- a) Manufacturer's name;
- b) Material;
- c) Distinguishing mark (to enable the particular item to be identified);
- d) Proof load applied;
- e) Safe working load;
- f) Factor of safety (as determined by destruction test on prototype);
- g) Details of heat treatment adopted;
- h) Report of examination and status of examiners;
- j) Type of cappel;
- k) A declaration that the item supplied comply in all respects with the standard; and
- m) Details of packing before dispatch.

ANNEX A

(Foreword)

A-1 INFORMATION TO BE GIVEN WITH ENQUIRY OR ORDER

The enquiry or order shall state the following:

- a) Designation of the components of the suspension gear and number required;
- b) Safe working load;
- c) Specification of material;
- d) Heat treatment desired;
- e) Whether anti-corrosive dressing is required;
- f) Length of chain sling from end to end;
- g) Size of chain in short link;
- h) Number of falls of chain slings; and
- j) Nominal diameter of rope and type of rope for cappel.

ANNEX B

(Clause 3.1)

B-1 STATIC OR SAFE WORKING LOAD

Safe working load shall consist of:

- a) *Static Load (Winding Material)*
 - 1) Weight of suspension gear,
 - 2) Weight of cage,
 - 3) Weight of material and its container, and
 - 4) Weight of balance rope, if used.
- b) *Static Load (Winding Men)*
 - 1) Weight of suspension gear,
 - 2) Weight of cage,
 - 3) Weight of men at 65 kg per head, and
 - 4) Weight of balance rope, if used.

ANNEX C

(Clause 9.4)

C-1 PERMISSIBLE IMPERFECTIONS FOR MAGNETIC PARTICLE INSPECTION

C-1.1 Magnetic particle flaw detection shall be carried out as per IS 3703. The type of defects and their limits are given in C-1.2, C-2 and C2.1.

C-1.2 Imperfections in components maybe in the form of:

- a) Non-metallic inclusions which are inherent in steels, and
- b) Cracks.

NOTE — Magnetic particle inspection will reveal these imperfections when they are on or just below the surface.

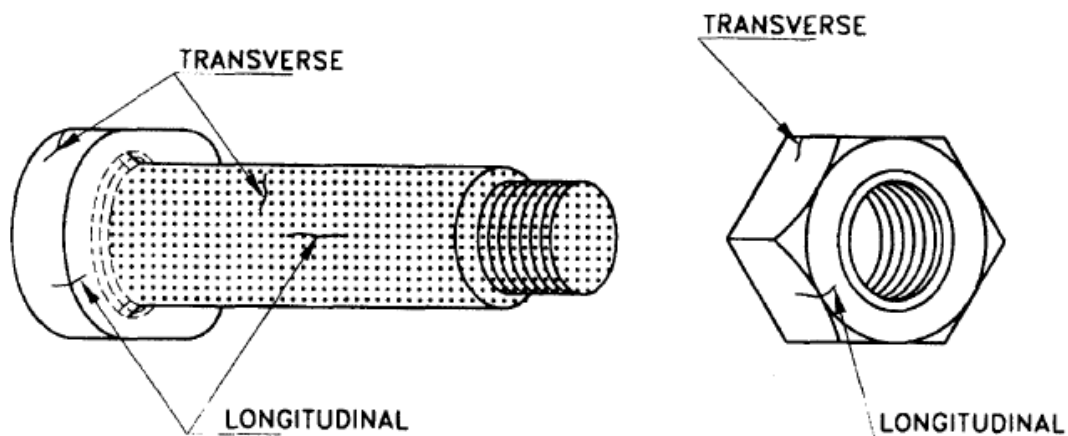
C-2 LIMITS OF PERMISSIBLE IMPERFECTIONS

The limits of permissible inclusions shall be as given in Fig. 4 to 13. Cracks shall not be permitted.

C-2.1 A longitudinal imperfection is one which generally runs parallel to the major dimension of the component and a transverse imperfection is one which runs at right angles to the line defined for a longitudinal imperfection.

C-3 RECORD

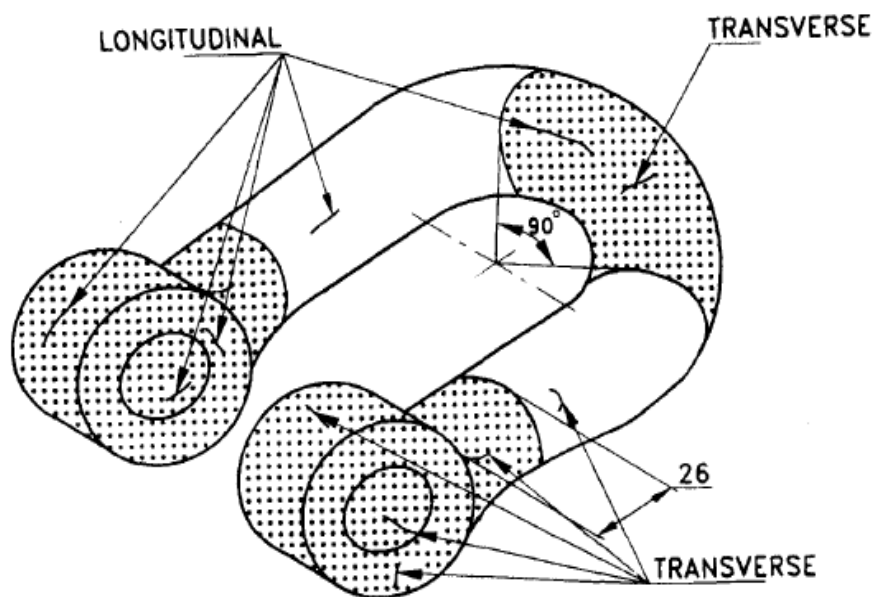
Imperfections which, although within the permissible limits, are of a large number, unusual pattern or direction, should be recorded on the component certificate.



<i>Part</i>	<i>Type of Imperfection</i>	<i>Permissible Imperfections</i>
<i>Shaded Areas</i>		
Pin, barrel and thread	Transverse	None
	Longitudinal	None >32 mm
<i>Unshaded Areas</i>		
Pin head and nut	Transverse	None > 10 mm
	Longitudinal	None >10 mm

All dimensions in millimetres.

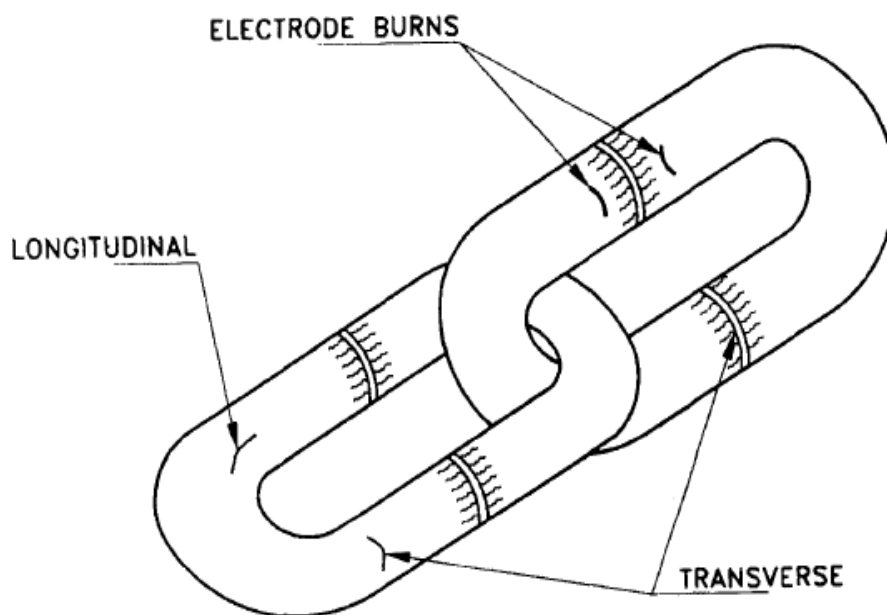
FIG. 4 PIN AND NUT



<i>Part</i>	<i>Type of Imperfection</i>	<i>Permissible Imperfections</i>
<i>Shaded Areas</i>		
Shackle body	Transverse	None
	Longitudinal	None >10 mm
<i>Unshaded Areas</i>		
Shackle body	Transverse	None
	Longitudinal	None >32 mm

All dimensions in millimetres.

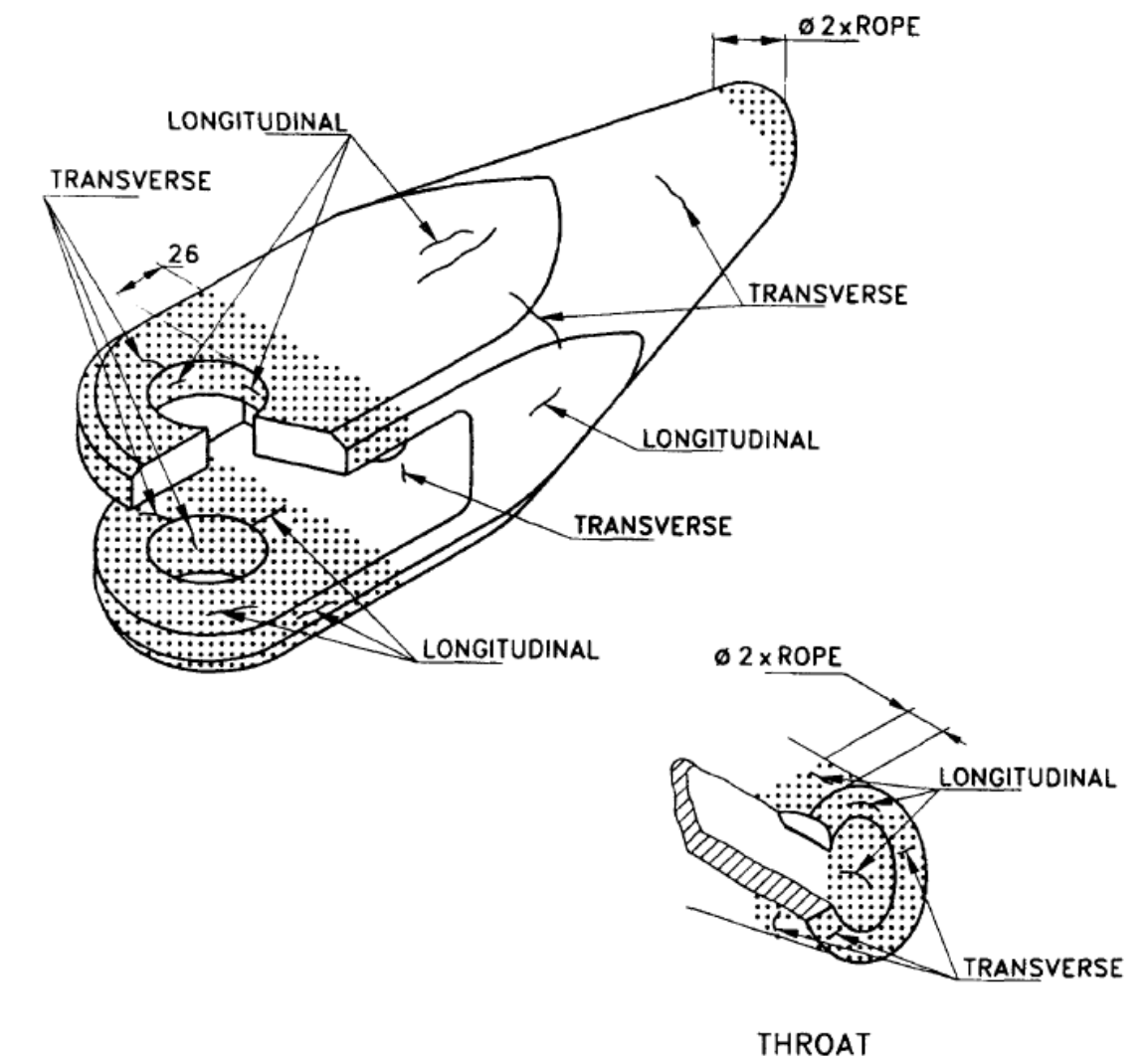
FIG. 5 SHACKLE BODY



<i>Part</i>	<i>Type of Imperfection</i>	<i>Permissible Imperfections</i>
<i>All Areas</i>		
Chain link	Transverse	None
	Longitudinal	None >10 mm
	Electrode Burns	None

All dimensions in millimetres.

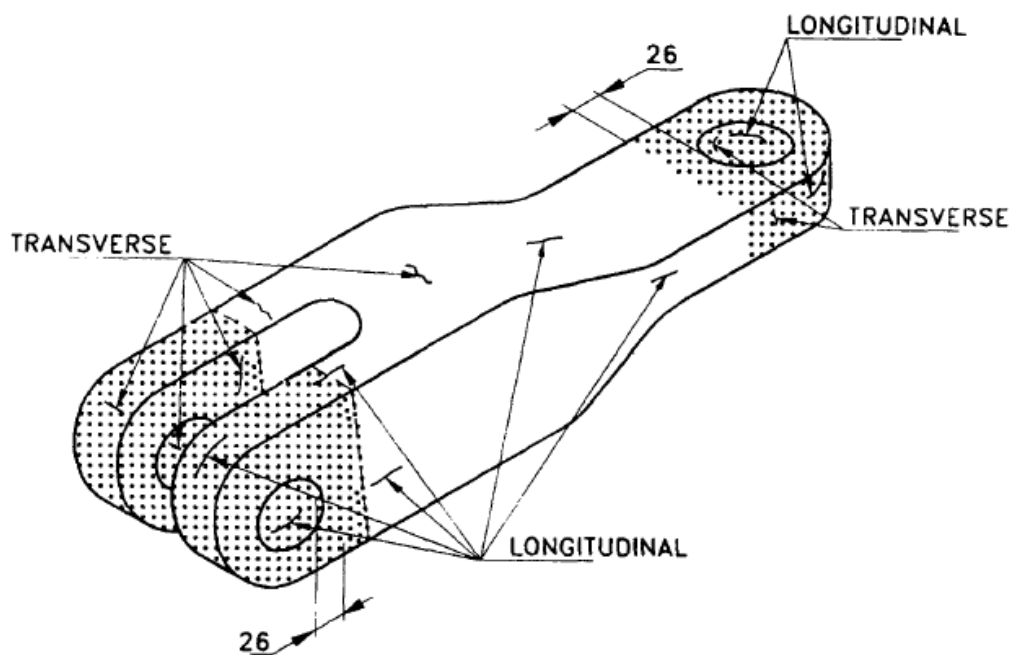
FIG. 6 CHAIN LINKS



Part	Type of Imperfection	Permissible Imperfections
<i>Shaded Areas</i>		
Surfaces and throat	Transverse	None
	Longitudinal	None >10 mm
Holes and edges	Transverse	None
	Longitudinal	None >16 mm
<i>Unshaded Areas</i>		
Body and edges	Transverse	None
	Longitudinal	None >32 mm

All dimensions in millimetres.

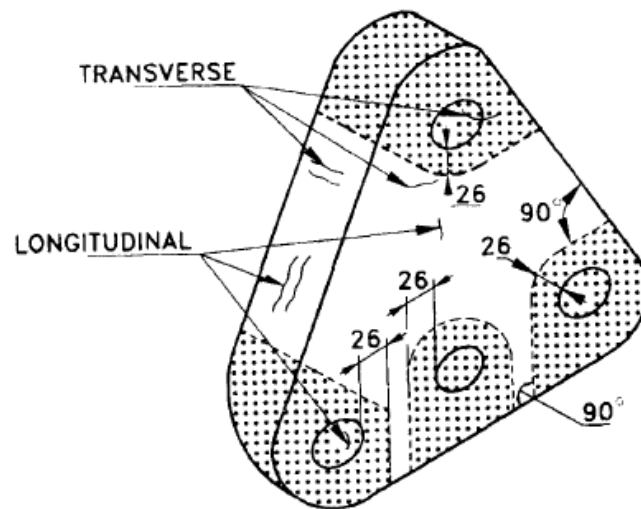
FIG. 7 WHITE METAL SOCKET



<i>Part</i>	<i>Type of Imperfection</i>	<i>Permissible Imperfections</i>
<i>Shaded Areas</i>		
Surfaces	Transverse	None
	Longitudinal	None >10 mm
Holes and edges	Transverse	None
	Longitudinal	None >16 mm
<i>Unshaded Areas</i>		
Body and edges	Transverse	None
	Longitudinal	None >32 mm

All dimensions in millimetres.

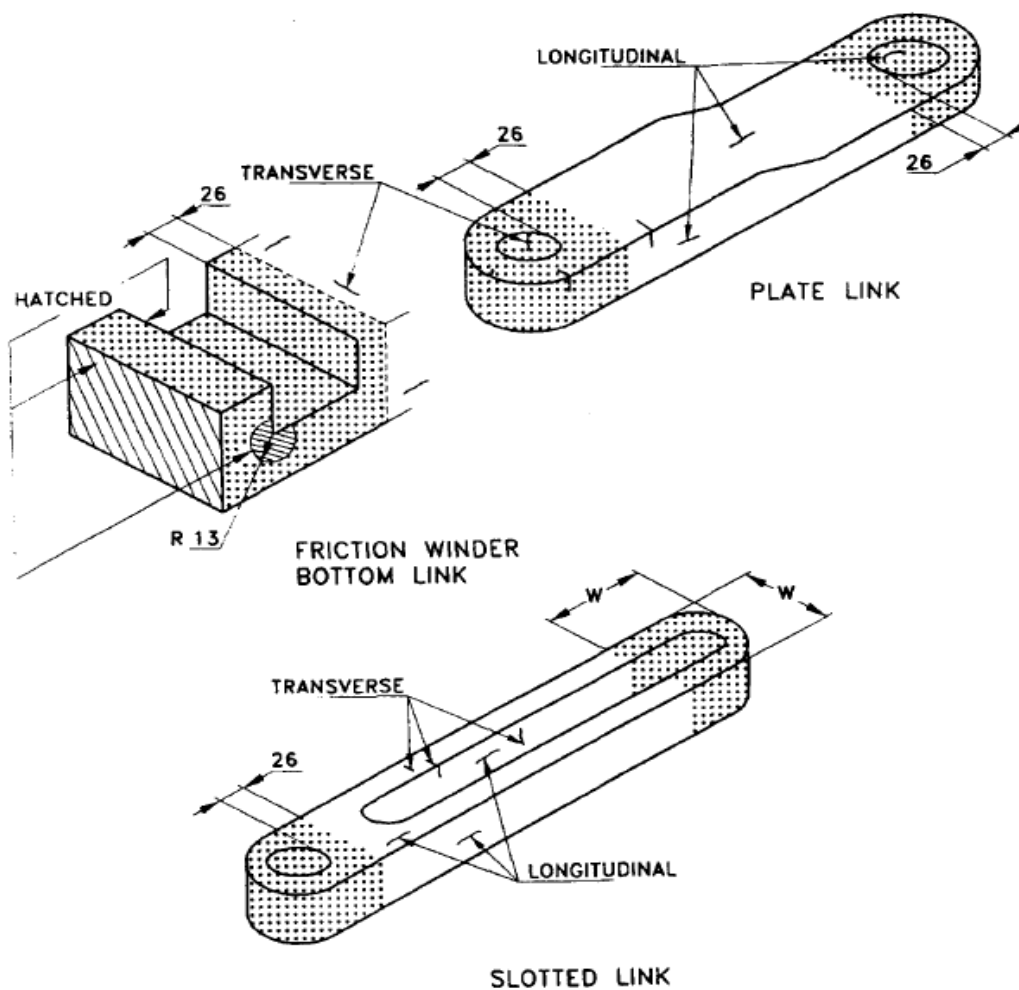
FIG. 8 CHASE BLOCK



<i>Part</i>	<i>Type of Imperfection</i>	<i>Permissible Imperfections</i>
<i>Shaded Areas</i>		
Plate surfaces	Transverse	None
	Longitudinal	None >10 mm
Plate edges	Transverse	None
	Longitudinal	None >32 mm
Holes	Transverse	None
	Longitudinal	None >16 mm
<i>Unshaded Areas</i>		
Plate surfaces	Transverse	None
	Longitudinal	None >32 mm
Plate edges	Transverse	None
	Longitudinal	None >64 mm

All dimensions in millimetres.

FIG. 9 DISTRIBUTION PLATE



Part	Type of Imperfection	Permissible Imperfections
<i>Shaded Areas</i>		
Plate surfaces	Transverse	None
	Longitudinal	None >10 mm
Plate edges	Transverse	None
	Longitudinal	None >32 mm
Holes and slot end	Transverse	None
	Longitudinal	None >16 mm
<i>Unshaded Areas</i>		
Surfaces	Transverse	None
	Longitudinal	None >32 mm
Plate edges and slots	Transverse	None
	Longitudinal	None >64 mm
Cantilever faces	Transverse or longitudinal	None

All dimensions in millimetres.

FIG. 10 PLATE AND SLOTTED LINKS

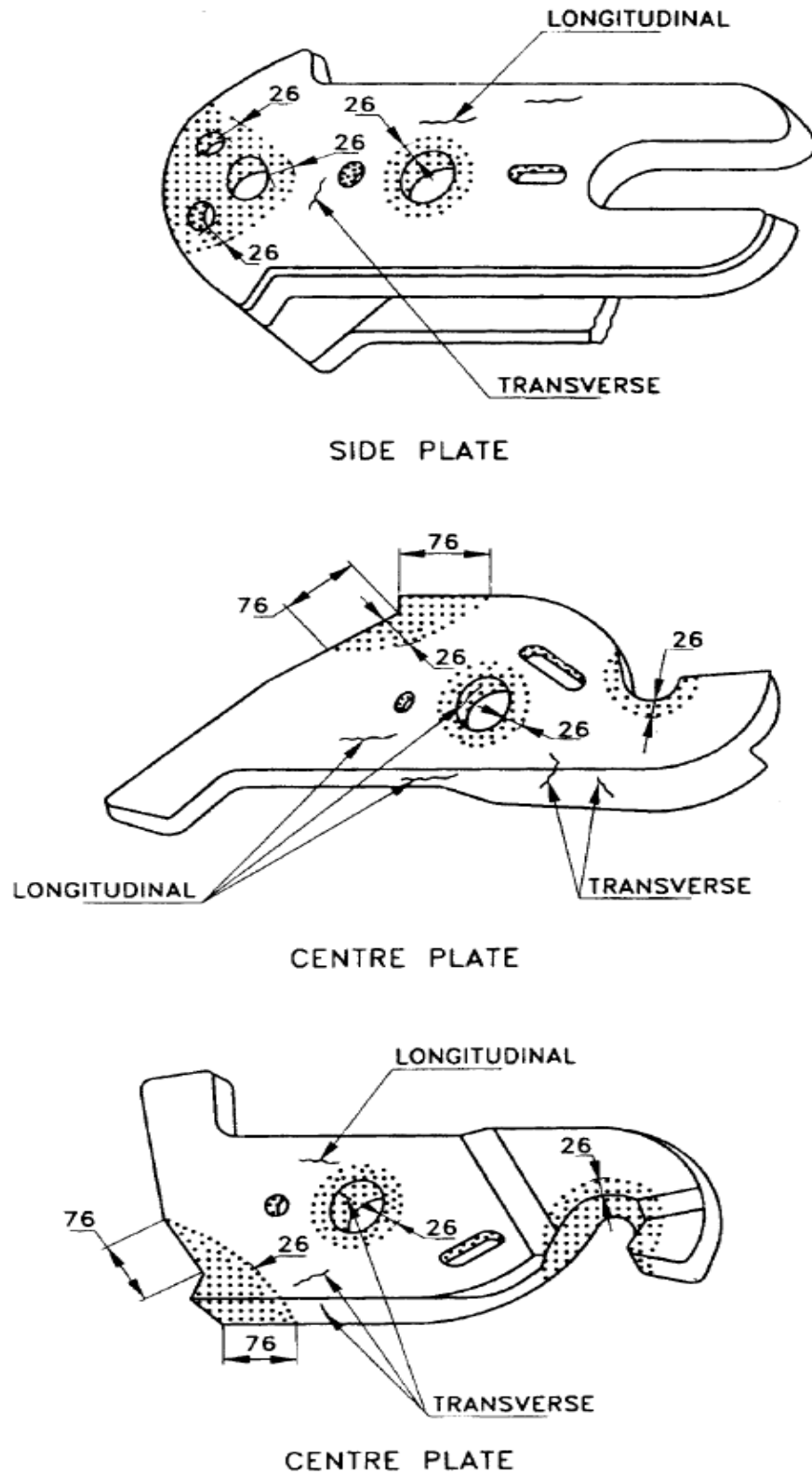
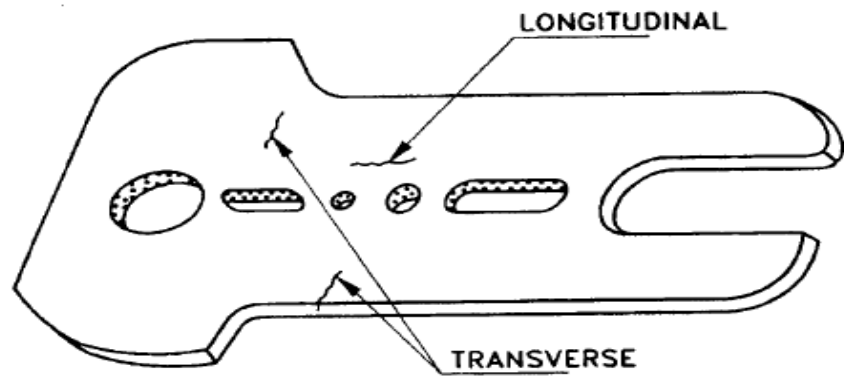


FIG. 11 HUMBLE DETACHING HOOK — *Contd.*

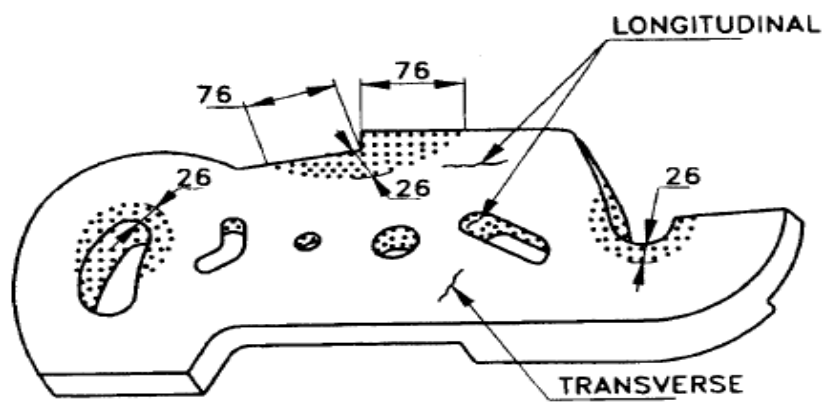
Part	Type of Imperfection	Permissible Imperfections
<i>Shaded Areas</i>		
Plate surfaces	Transverse	None
	Longitudinal	None >10 mm
Plate edges	Transverse	None
	Longitudinal	None >32 mm
Holes and slots	Transverse	None
	Longitudinal	None >16 mm
<i>Unshaded Areas</i>		
Plate surfaces and slots	Transverse	None
	Longitudinal	None >32 mm
Plate edges and slots	Transverse	None
	Longitudinal	None >64 mm

All dimensions in millimetres.

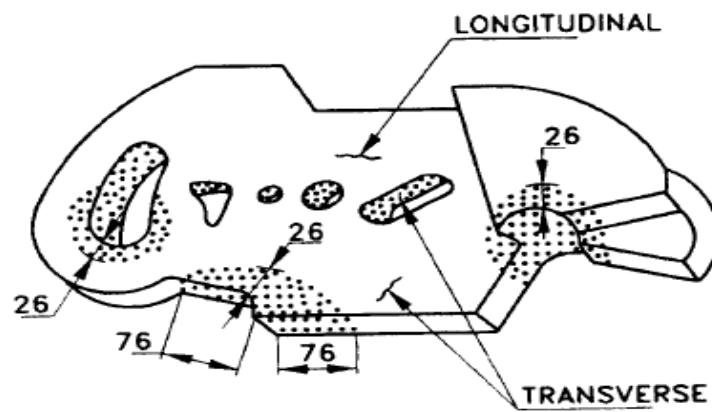
FIG. 11 HUMBLE DETACHING HOOK



SIDE PLATE



CENTRE PLATE



CENTRE PLATE

FIG. 12 KING DETACHING HOOK — *Contd.*

<i>Part</i>	<i>Type of Imperfection</i>	<i>Permissible Imperfections</i>
<i>Shaded Areas</i>		
Plate surfaces	Transverse	None
	Longitudinal	None >10 mm
Plate edges	Transverse	None
	Longitudinal	None >32 mm
Holes and slots	Transverse	None
	Longitudinal	None >16 mm
<i>Unshaded Areas</i>		
Plate surfaces and slots	Transverse	None
	Longitudinal	None >32 mm
Plate edges	Transverse	None
	Longitudinal	None >64 mm

All dimensions in millimetres.

FIG. 12 KING DETACHING HOOK

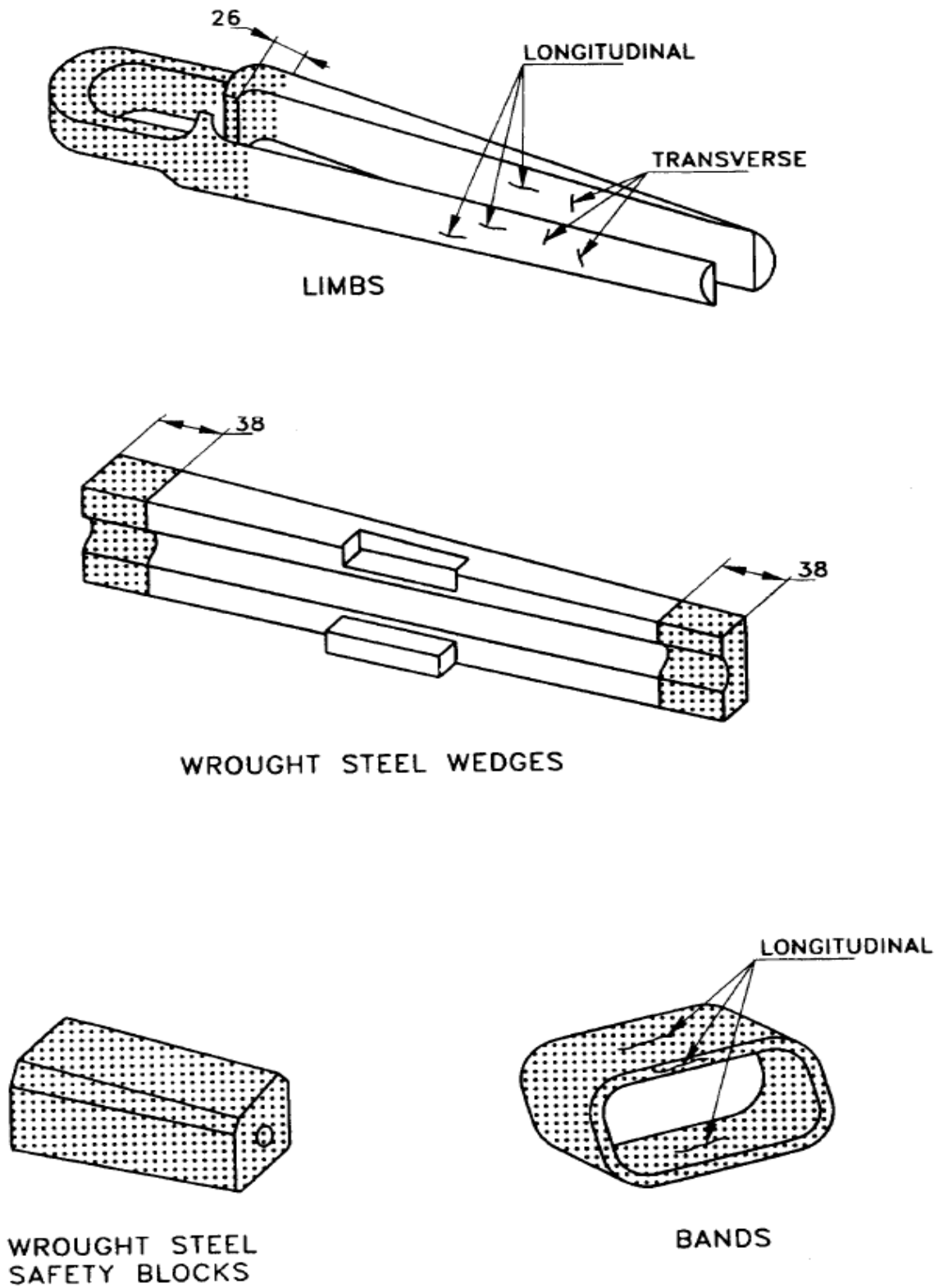


FIG. 13 CAPEL — *Contd.*

<i>Part</i>	<i>Type of Imperfection</i>	<i>Permissible Imperfections</i>
<i>Shaded Areas</i>		
Bands, safety block and wedges	Transverse	None
	Longitudinal	None >10 mm
Limbs	Transverse	None
	Longitudinal	None >16 mm
<i>Unshaded Areas</i>		
Wedges	Transverse	None
	Longitudinal	None >32 mm
Limbs	Transverse	None
	Longitudinal	None >64 mm

All dimensions in millimetres.

FIG. 13 CAPEL

ANNEX D

(Foreword)

COMMITTEE COMPOSITION

Mining Techniques and Equipment Sectional Committee, MED 08

<i>Organisations</i>	<i>Representative(s)</i>
DTE General of Mines Safety, Dhanbad	SHRI PRABHAT KUMAR (Chairman) SHRI M. ARUMUGAM (<i>Alternate</i>)
Andhra Pradesh Heavy Machinery & Engg Ltd, Vijaywada	SHRI T. V. RAMANA SHRI B. MAHIDHAR (<i>Alternate</i>)
Bharat Coking Coal Ltd, Dhanbad	SHRI P. K. SINHA
Bharat Earth Movers Ltd., Bangalore	SHRI CH V. R. S. PRASAD RAO SHRI H. S. SATISH HANDRA (<i>Alternate</i>)
Caterpillar Ltd, Bangaluru	SHRI K. REJI JOSE SHRI R. SRINIVASA RAO (<i>Alternate</i>)
Central Mine Planning & Design Institute Ltd, Ranchi	SHRI S. K. CHATERJI SHRI U. ROY (<i>Alternate</i>)
Central Institute of Mining and Fuel Resesarch, Dhanbad	SHRI M. K. SINGH SHRI SURAJIT DEY (<i>Alternate</i>)
Eastern Coalfields Limited, Sanctoria	DR MANAS KUMAR MISHRA
Eimco Elecon (India) Ltd, Vallabh Vidyanagar	SHRI B. K. BHATT
Hindustan Copper Ltd, Kolkata	SHRI R. C. SINGLA SHRI P. K. SHARMA (<i>Alternate</i>)
Hindustan Zinc Limited, Udaipur	SHRI B. V. RAO
John Deere Ltd, Pune	SHRI KALIAPPAN KARTHIK SHRI VIVEK JOSHI (<i>Alternate</i>)
Manganese Ore (India) Ltd, Nagpur	SHRI RAJESH VERMA SHRI ATUL SHARMA (<i>Alternate</i>)
Nanda Millar Co, Kolkata	SHRI J. P. GOENKA SHRI PANKAN GOENKA (<i>Alternate</i>)
National Mineral Development Corpn, Hyderabad	SHRI A. K. GUPTA SHRI A. K. SHUKLA (<i>Alternate</i>)
South Eastern Coalfields Ltd, Bilaspur	SHRI KAPIL K. RAI SHRI D. BHATTACHARJEE (<i>Alternate</i>)
Tata Steel Ltd	SHRI SOUMENDU KUMAR MANJHI SHRI ABINASH JHA (<i>Alternate</i>)
The Hutti Gold Mines Company Ltd, Distt Raichur	DR M. L. PATIL
The Singareni Collieries Co Ltd, Distt Khammam	SHRI P. VISWANADHA RAJU SHRI CH V. JANARDHANA RAO (<i>Alternate</i>)
BIS Directorate General	SHRI RAJNEESH KHOSLA, SCIENTIST 'E' AND HEAD (MED) REPRESENTING DIRECTOR GENERAL (<i>Ex-officio</i>)

Member Secretary

SHRI SANDEEP KESHAV
SCIENTIST 'B' (MED), BIS

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Review of Indian Standards

Amendments are issued to standards as the need arises on the basis of comments. Standards are also reviewed periodically; a standard along with amendments is reaffirmed when such review indicates that no changes are needed; if the review indicates that changes are needed, it is taken up for revision. Users of Indian Standards should ascertain that they are in possession of the latest amendments or edition by referring to the latest issue of 'BIS Catalogue' and 'Standards: Monthly Additions'.

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Amendments Issued Since Publication

Amend No.	Date of Issue	Text Affected

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Eastern	: 1/14 C.I.T. Scheme VII M, V.I.P. Road, Kankurgachi KOLKATA 700054	{ 2337 8499, 2337 8561 2337 8626, 2337 9120
Northern	: Plot No. 4-A, Sector 27-B, Madhya Marg CHANDIGARH 160019	{ 265 0206 265 0290
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